

[Detailed Description of the Invention]

[0001]

[Field of the Invention]Especially this invention relates to the vertical thermal treatment equipment which can prevent breakage of the boat and wafer resulting from a crack of the wafer after heat treatment about vertical thermal treatment equipment.

[0002]

[Description of the Prior Art]Drawing 3 is a schematic diagram of conventional vertical thermal treatment equipment.

[0003]The vertical thermal treatment equipment 100 is provided with the wafer transfer machine 130 which conveys the wafer 101 between the wafer cassette 110, the boat 120 holding the wafer 101, and the wafer cassette 110 and the boat 120, and the heat treating furnace 140 arranged above the boat 120.

[0004]The heat treating furnace 140 consists of the furnace body 140A and the door 140B, and the boat 120 is laid on the door 140B. As the rising and falling mechanism which is not illustrated shows to the arrow a, it moves in the door 140B and the boat 120, and the boat 120 is inserted into the furnace body 140A, and the boat 120 is pulled out from the inside of the furnace body 140A.

[0005]In this vertical thermal treatment equipment 100, after heat treatment is performed within the furnace body 140A, the wafer 101 is pulled out from the throat area 141 which carries out an opening caudad, and are collected by the wafer cassette 110 with the wafer transfer machine 130 after that.

[0006]

[Problem(s) to be Solved by the Invention]By the way, since the wafer 101 on the boat 120 is heat-treated as mentioned above, it may be divided by heat stress.

[0007]If the wafer transfer machine 130 is made to advance to the boat 120 when this wafer 101 has broken in order to collect the wafers 101 on the boat 120, TSUIZA 131 of the wafer transfer machine 130 and the wafer 101 on the boat 120 will contact, and the boat 120 and the wafer 101 will be damaged.

[0008]This invention was made in view of such a situation, and that technical problem is in providing the vertical thermal treatment equipment which can prevent beforehand the boat at the time of taking out the wafer after heat treatment from a boat with a wafer transfer machine, and breakage of a wafer.

[0009]

[Means for Solving the Problem]In order that this invention may solve an aforementioned problem, vertical thermal treatment equipment of the invention according to claim 1, Vertical thermal treatment equipment provided with a wafer transfer machine which conveys said wafer between a wafer cassette, a boat which holds a wafer to multistage, and said wafer cassette and said boat, and a heat treating furnace arranged above said boat is characterized by comprising: A wafer detection means to detect said wafer held on said boat by making it go up and down said boat.

A boat ascending and descending position detection means to detect a position of said boat.

A control means which compares number of sheets of said wafer at the time of a boat rise detected based on an output of said wafer detection means and said boat ascending and descending position detection means, respectively, and descent, and stops wafer conveying operation of a wafer transfer machine from said boat to a wafer cassette according to a comparison result.

[0010]When taking out a wafer after heat treatment from a boat with a wafer transfer machine, Since wafer conveying operation from a boat of a wafer transfer machine to a wafer cassette is

stopped according to a comparison result of number of sheets of a wafer detected at the time of a boat rise and descent, breakage of a wafer by collision with a wafer on a boat and a wafer transfer machine or a boat can be suppressed.

[0011]In the vertical thermal treatment equipment according to claim 1, said control means compares number of sheets of said wafer detected, respectively at the time of a rise and descent, and vertical thermal treatment equipment of the invention according to claim 2 emits warning, when not in agreement.

[0012]Since number of sheets of a wafer detected, respectively at the time of a rise and descent is compared, and an alarm is emitted when not in agreement, it can know promptly that a breakage accident of a wafer, etc. occurred.

[0013]

[Embodiment of the Invention]Hereafter, this embodiment of the invention is described based on a drawing.

[0014]Drawing 1 is a schematic diagram of the vertical thermal treatment equipment concerning one embodiment of this invention.

[0015]Vertical thermal treatment equipment is provided with the following.

Wafer cassette 10.

Boat 20.

Wafer transfer machine 30.

The heat treating furnace 40, the transmission type sensor 50, the wafer primary detecting element 60, the boat ascending and descending position primary detecting element (boat ascending and descending position detection means) 70, the mechanism control section (control means) 80, and the alarm (alarm) 90.

A wafer detection means comprises the transmission type sensor 50 and the wafer primary detecting element 60.

[0016]The wafer cassette 10 is loaded with two or more wafers 1.

[0017]The heat treating furnace 40 consists of the furnace body 40A which has the throat area 41 which is turned caudad and carries out an opening, and the door 40B which closes the throat area 41, and heat-treats the wafer 1.

[0018]The quartz boat (boat) 20 laid on the door 40B down the heat treating furnace 40 is allocated. It moves, as the rising and falling mechanism which is not illustrated shows to the arrow b, and the boat 20 is inserted into the furnace body 40A, and the door 40B is pulled out out of the furnace body 40A.

[0019]The slot which is not illustrated in the boat 20 is formed in multistage in accordance with the move direction, and two or more wafers 1 are held at these slots.

[0020]The transmission type sensor 50 which detects two or more wafers 1 held at the slot is allocated in the throat area 41.

[0021]This transmission type sensor 50 consists of the light projection part 51 and the light sensing portion 52.

[0022]The light projection part 51 consists of light emitting devices, such as a light emitting diode, and the light sensing portion 52 consists of photo detectors which receive the light which penetrated between the wafers 1, such as a PIN photodiode and a photo-transistor.

[0023]The amplifier in which the wafer primary detecting element 60 amplifies the light-receiving output of a photo detector, for example, When H level meaning not having detected the wafer and the level of a light-receiving signal are less than a detection threshold while the level of the amplified light-receiving signal was over the detection threshold, the wafer detecting signal 60a containing L level meaning having detected the wafer is outputted.

[0024]The boat ascending and descending position primary detecting element 70 has a motor which moves the door 40B vertically, for example, and a rotary encoder (neither is illustrated)

which detects the position of the door based on the rotation of a motor, and outputs the boat ascending and descending position signal 70a.

[0025]The mechanism control section 80 has memorized a wafer detection start position and wafer detection end position, and counts the number of sheets of a wafer based on the wafer detecting signal 60a and the boat ascending and descending position signal 70a between a wafer detection start position and wafer detection end position. For example, as shown in drawing 4, in a field without a crack, L level appears in a short rule target between H levels, but in the field which the crack has produced, L level appears in a wafer for a long period of time. In the field which fall of the wafer has produced, L level does not come out to the timing which should come out. Therefore, L level which has come out during the short period is counted, and the number of sheets of a wafer is counted.

[0026]The wafer transfer machine 30 has two or more TSUIZA 31, and conveys conversely the wafer 1 held on TSUIZA 31 from the wafer cassette 10 from the boat 20 to the wafer cassette 10 to the boat 20.

[0027]The schematic diagram of the vertical thermal treatment equipment which drawing 2 (a) shows the state before detection of a wafer, the schematic diagram of the vertical thermal treatment equipment which drawing 2 (b) shows the state at the time of the detection start of a wafer, and drawing 2 (c) are the schematic diagrams of the vertical thermal treatment equipment in which the state at the time of the end of detection of a wafer is shown.

[0028]Next, with reference to drawing 1 and drawing 2 (a) - drawing 2 (c), the wafer detecting operation by the mechanism control section 80 is explained.

[0029]** In order to heat-treat the wafer 1 conveyed from the wafer cassette 10 to the boat 20, drive a motor and insert the boat 20 into the furnace body 40A. At this time, the number of sheets of the wafer 1 inserted into the furnace body 40A based on the wafer detecting signal 60a and the boat ascending and descending position signal 70a of H level is counted, and that number of sheets is memorized.

[0030]** After heat treatment of the wafer 1, drive a motor to an opposite direction with **, and start descent of the boat 20 (door 40B) (drawing 2 (a)). Simultaneously, the light projection part 51 starts floodlighting.

[0031]** When it detects having reached wafer detection start position DS which descended as the boat 20 showed by the arrow c, and was set up beforehand with the boat ascending and descending position signal 70a, The count of the number of sheets of the wafer 1 pulled out out of the furnace body 40A based on the wafer detecting signal 60a of H level outputted from the wafer primary detecting element 60 is started (refer to drawing 2 (b)).

[0032]** As the boat 20 shows by the arrow d, descend further, and when it detects having reached wafer detection end position DE set up beforehand with the boat ascending and descending position signal 70a, end the count of the number of sheets of the wafer 1 (drawing 2 (c)).

[0033]** When the wafer number of sheets remembered to be the detected wafer number of sheets is compared and both number of sheets differs, The warning sound (warning) which tells that there is breakage of the wafer 1 by the alarm 90 is outputted, and the conveying operation of the wafer 1 from the boat 20 performed at the following step to the wafer cassette 10 is forbidden.

[0034]Since breakage of a wafer is detectable by wafer number of sheets when pulling out the boat 20 from the time of inserting in the furnace body 40A, and the furnace body 40A according to this embodiment, breakage of the wafer 1 and the boat 20 can be suppressed to the minimum.

[0035]Since breakage of the wafer 1 can be promptly known by the alarm 90, the wafer 1 damaged immediately can be removed and the stop time (down time) of vertical thermal treatment equipment can be shortened.

[0036] Since breakage of the wafer 1 is detected using rise and fall of the boat 20 before and behind processing, a throughput (quantity of the wafer 1 which can be processed in unit time) is not reduced.

[0037] It does not restrict to what generates a sound like alarm as a warning, and a lamp may be blinked or blink of alarm and a lamp may be made to perform simultaneously.

[0038] Two or more transmission type sensors may be allocated in the move direction of a boat. In this case, when not detected as there being the wafer 1 by all transmission type sensors, the wafer conveying operation from a boat to a wafer cassette is forbidden.

[0039] Although this embodiment explained using the transmission type sensor, it replaces with a transmission type sensor and may be made to detect the existence of the wafer 1 with this reflection type sensor using a reflection type sensor.

[0040] Although it was made to detect by counting the number of sheets of the wafer in which the number which carried out wafer conveyance is inserted into a furnace body, a wafer sensor is formed in a wafer transfer machine, and it may be made to count directly the number of wafers conveyed on the boat.

[0041] A wafer can apply this invention also to the vertical mold processing unit provided with the membrane formation processing furnace other than vertical thermal treatment equipment provided with the heat treating furnace by being divided after membrane formation processing at a case.

[0042]

[Effect of the Invention] As explained above, according to the vertical thermal treatment equipment of the invention according to claim 1. Breakage of the wafer by the collision with the wafer and wafer transfer machine at the time of taking out the wafer after heat treatment from a boat with a wafer transfer machine or a boat is suppressed, and the damage caused by the collision with a wafer and a wafer transfer machine can be stopped to the minimum. Since breakage of a wafer is detected using rise and fall of the boat before and behind processing, a throughput is not reduced.

[0043] Since it can know promptly that breakage of the wafer, etc. occurred by warning according to the vertical thermal treatment equipment of the invention according to claim 2, it can be coped with promptly [an accident] and the stop time (down time) of a device can be shortened.